

Baroclinic inertia-gravity wave turbulence and its effects on
diffusion and fluctuations of ocean tracers

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ABSTRACT

Long internal gravity waves - also known as baroclinic inertia-gravity (BIG) waves - have a strong signature in sea surface height variations, thus calling for a more accurate interpretation of satellite altimeter data for ocean studies and climate modeling. However, these waves are also of great intrinsic interest. Ubiquity of the BIG waves in the world ocean prompts quest about a possible role for these broad-band oscillations in ocean dynamics and climate. In particular, BIG wave turbulence may induce "turbulent" transport and fluctuations of ocean tracers (e.g., heat and bio-geochemical quantities).

A theory of wave-induced diffusion, initiated by Herterich and Hasselmann in 1981, has now been extended to weakly nonlinear waves of general nature, including BIG waves. The weak nonlinearities allow the derivation of essential exact closed-form expressions for the transport coefficients (drift velocity and diffusion tensor) in terms of the wavenumber-frequency spectrum of the waves.

In the present talk, experimental and theoretical results on BIG wave turbulence and its effects on ocean tracers are reviewed. Among its accomplishments, the theory successfully explains observed spectra of tracer spatial fluctuations. Horizontal mean drift and diffusion coefficients are found to be of a sufficient magnitude to make this transport mechanism important in some ocean regions. Several outstanding issues of immediate importance to ocean dynamics - mostly those related to the horizontal inhomogeneity of ocean wave fields (as caused, e.g., by the latitudinal dependence of the Coriolis parameter) - are highlighted.